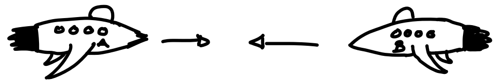
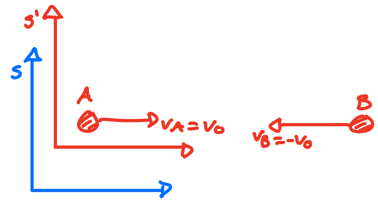
Taylor Larrechea
Dr. Middleton
PHYS 230 HW 6

1. Helliwell: 1-2



$V_x' = V_x - V$
$V_y' = V_y$
$V_z' = V_z$

a.) B's velocity in A's frame

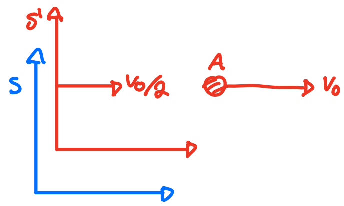


$V = V_0$ (S' velocity RT to S)
$V_x = -V_0$ (B's velocity RT to S)

$V_x' = -V_0 - V_0 = -2V_0$

$V_x' = -2V_0$

b.) A's velocity in a frame moving to right $V = V_0/2$



$V = V_0/2$ (Frame velocity)
$V_x = V_0$ (A's velocity)

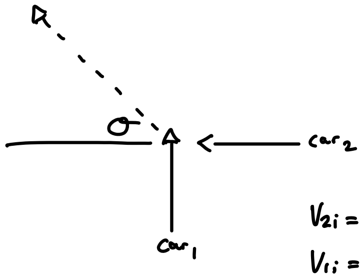
$V_x' = V_x - V = V_0 - V_0/2 = V_0/2$

$V_x' = V_0/2$

2. Helliwell: 1-7

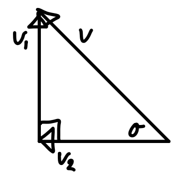
$\theta = 45°$

$P_i = P_f \quad \because P = mv$



$V_{2i} = -30\ mi/hr$

$V_{1i} = ?$



Final velocity, and initial velocity of car 1

For car 1:

$m_f = 3m$

$P_i = P_f \quad :$

$m_1 = m$

$m_{1i} V_{1i} = m_{1f} V_{1f}$

$m V_{1i} = 3m V_{1f}$

$V_{1i} = 3 V_{1f}$

$V_{1i} = 3 v \sin\theta$

$V_{1f} = V \sin\theta$

$V = \dfrac{V_{1i}}{3 \sin\theta}$

For Car 2:

$P_i = P_f$

$m_2 = 2m$

$m_{2i} V_{2i} = m_{2f} V_{2f}$

$2m V_{2i} = 3m V_{2f}$

$V_{2i} = \frac{3}{2} V_{2f}$

$V_{2i} = -\frac{3}{2} V \cos\theta$

$V_{2f} = -V \cos\theta$

$V = \dfrac{-2 V_{2i}}{3 \cos\theta}$

$$\frac{V_{1i}}{3 \sin\theta} = \frac{-2 V_{2i}}{3 \cos\theta}$$

$$V_{1i} = \frac{-2 V_{2i} (3 \sin\theta)}{3 \cos\theta}$$

$V_{1i} = -2 V_{2i} \cdot \tan\theta$

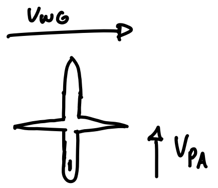
$V_{1i} = -2 \cdot (-30\ mi/hr) \cdot \tan(45) = 60\ mi/hr$

$V = \dfrac{V_{1i}}{3 \sin\theta} = \dfrac{60\ mi/hr}{3 \cdot \sin(45)} = 28.2\ mi/hr$

$V_{1i} = 60\ mi/hr$ due N.

$V_f = 28\ mi/hr$ NW

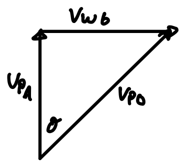
3. Helliwell: 2-4



V_{xy}
x- object
y- RT

P= Plane G= Ground
A= Air W= wind
O= observers

a.) Plane Velocity RT observers ?



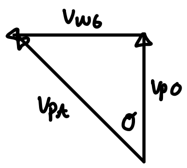
$V_{PA} = 50$ m/s
$V_{WG} = 40$ m/s

$$V_{PO} = \sqrt{V_{PA}^2 + V_{WG}^2} = \sqrt{(50\,m/s)^2 + (40\,m/s)^2} = 64\ m/s$$

$$\tan\theta = \frac{V_{WG}}{V_{PA}} \quad \therefore \quad \theta = \tan^{-1}\left(\frac{V_{WG}}{V_{PA}}\right) = \tan^{-1}\left(\frac{40\,m/s}{50\,m/s}\right) = 38.6 \approx 39^{\circ}$$

$V_{PO} = 64$ m/s
$\theta = 39^{\circ}$ cw Due N.

b.) Relative to Ground



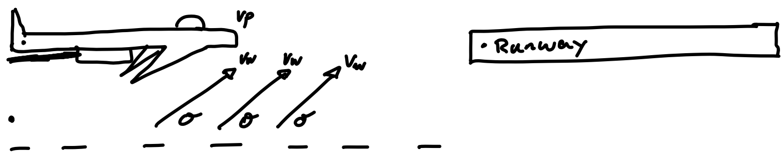
$V_{WG} = 40$ m/s
$V_{PA} = 50$ m/s

$$V_{PA}^2 = V_{WG}^2 + V_{PO}^2 \quad \therefore \quad V_{PO} = \sqrt{V_{PA}^2 - V_{WG}^2} = \sqrt{(50\,m/s)^2 - (40\,m/s)^2} = 30\ m/s$$

$$\sin\theta = \frac{V_{WG}}{V_{PA}} \quad \therefore \quad \theta = \sin^{-1}\left(\frac{V_{WG}}{V_{PA}}\right) = \sin^{-1}\left(\frac{40\,m/s}{50\,m/s}\right) = 53.1^{\circ} \approx 53^{\circ}$$

$V_{PO} = 30$ m/s
$\theta = 53^{\circ}$ ccw due N

4. Helliwell: 2-6



$V_w = 25\ ^{mi}/_{hr}$ $\quad V_p = 25\ ^{mi}/_{hr}$

a.) What angle should the pilot angle her craft?

$V_w \sin\theta = V_p \sin\theta$

$\sin\theta = \dfrac{V_w \sin\theta}{V_p}$

$\theta = \sin^{-1}\left(\dfrac{V_w \sin\theta}{V_p}\right) = \sin^{-1}(\sin\theta) = \theta$

The pilot should angle her craft 60° below the horizontal because this angle will eliminate the y-component of the winds influence and have a component only in the x.

$\theta = 60°$ South of E

b.) Since runway is in x-direction

$$V_w\cos\theta + V_p\cos\theta = V = (V_w + V_p)\cos\theta = (25\ ^{mi}/_{hr} + 25\ ^{mi}/_{hr})\cos\theta = (50\ ^{mi}/_{hr})\cos\theta$$

$V = 50\cos\theta$

$D = 5\,mi$

$$\Delta t = \frac{D}{V} = \frac{5\,mi}{50\,mi/hr \cdot \cos\theta} = 0.2\ hr = 12\ min$$

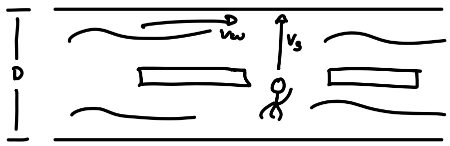
12 min to reach runway

5. Helliwell: 2-8

$V_W = 0.50\ m/s$

$V_S = 1.00\ m/s$

$D = 35\ m$



a.) How long does it take the swimmer to reach the other side?
How far is he swept downstream?

i.) $V = \frac{D}{t}\ \therefore\ t = \frac{D}{V}$ $\quad \Delta t = \frac{35\,m}{1.00\,m/s} = 35\,s$

$D = 35\,m$

$V = 1.00\,m/s$

$\Delta t = 35\,s$
$D = 18\,m$

ii.) water current : $V_W = 0.50\ m/s$

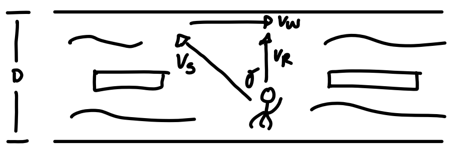
Swept downstream : $D = V \cdot \Delta t = 0.50\,m/s\,(35\,s) = 17.5\,m \approx 18\,m$

b.) What angle must the swimmer swim at to reach exactly the opposite side?
How long to reach the other side here?

$V_S = 1.00\ m/s$ $\quad \theta = 30^\circ$

$V_W = 0.50\ m/s$

$V_R = 0.87\ m/s$



$V_S^2 = V_R^2 + V_W^2\ \therefore\ V_R = \sqrt{V_S^2 - V_W^2} = \sqrt{(1.00\,m/s)^2 - (0.50\,m/s)^2} = 0.866\,m/s \approx 0.87\,m/s$

i.) $\sin\theta = \frac{V_W}{V_S}\ \therefore\ \theta = \sin^{-1}\left(\frac{V_W}{V_S}\right) = \sin^{-1}\left(\frac{0.50\,m/s}{1.00\,m/s}\right) = 30^\circ$ $\quad \theta = 30^\circ$

ii.) $v = \frac{D}{t}\ \therefore\ t = \frac{D}{V}$ $\quad \Delta t = \frac{35\,m}{0.87\,m/s} = 40.2\,s \approx 40\,s$

$D = 35\,m$

$V = 0.87\,m/s$

$\theta = 30^\circ$ upstream
$\Delta t = 40\,s$ to cross